

Hydraulic steel works: a case study in subcontracting for hydro projects

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There is no consensus on the best way to contract for the design, construction and installation of hydraulic steel works for a hydropower project. This paper examines the rationale for, and advantages and disadvantages of, various procurement approaches for hydraulic steel works. The paper will also discuss legal and commercial issues relating to such procurement, including indexation, use of local as opposed to foreign contractors, design responsibility, the defects notification period, interface risk, price and payment mechanisms, testing and commissioning, size of packages, as well as requirements for project finance.

Within the hydropower industry there are many ways to contract for hydraulic steel works. A project owner may choose to contract directly by way of one or more separate contracts. Alternatively, an owner may include these works in another contract such as: an engineering, procurement and construction contract (EPC contract) for the entire scope of the construction works for the project; an electro-mechanical contract for the supply, installation, testing and commissioning of turbines, generators, transformers and other equipment; or, a civil works contract for the construction of the project. If it is decided to include the hydraulic steel works as part of another contract, the owner will also face certain choices over how involved the organization wishes to be with the selection of the hydraulic steel works subcontractor(s) and the works themselves. The more involved owner may wish to select a particular hydraulic steel works subcontractor as a nominated subcontractor.

What are hydraulic steel works?

In the context of hydropower, hydraulic steel works include, but are not limited to, the works relating to the following steel items of plant used to control water flows: intake steel structures; gates (flap, cylinder, stoplog, slide, caterpillar, mitre, roller, segment, sector, drum, fixed-wheel and visor [IFC, 2016¹]); steel linings for penstocks, draft tubes and surge shafts; valves (butterfly, inlet, dissipating and regulating); distributor vanes; trashracks and trashrakes (for intakes and surge tank structures); and, bifurcations and manifolds. Works is a broad term for physical activities including fabrication, supply, construction, installation, testing and commissioning based on the scope defined in the relevant contract.

The term 'hydraulic steel works' is often used synonymously with the term 'hydro-mechanical works'. Although not strictly hydraulic, scope for hydraulic steel works can also include other steel items such as a gantry crane (for a powerhouse or intake gates of a headrace tunnel), an overhead crane (for the outlet of a headrace tunnel), and even the steel roof of a powerhouse. Hydraulic steel works can represent between 1 and 15 per cent of the total construction costs for a hydropower project^(a).

^(a) Based on the results of a survey done by the author within the international hydropower industry for the purposes of researching this paper, May-August 2016.

Procurement of hydraulic steel works under stand-alone contracts

Procuring hydraulic steel works for hydropower projects as one or more stand-alone contracts is a common approach in markets in places such as India, where the local specialist capacity for hydraulic steel works is well developed. This means that, where hydraulic steel works are procured as one or more stand-alone contracts, the contractor(s) for the works tend to be local.

The main advantages for procuring hydraulic steel works separately come down to price and control. Significant savings on price compared with the marked-up prices of foreign suppliers can usually be made as a result of local suppliers' knowledge of the local supply chain for steel and steel products, specialist experience with hydropower-related items such as penstocks and gates, and reduced logistics costs. A direct contractual relationship allows for control over the contractor and the ability to apply specific measures in case of any delays and/or other issues arising during the design, installation and testing of hydraulic steel works.

In addition, contracting separately for hydraulic steel works allows an appropriate form of contract for these works to be used, requiring minimal changes, as opposed to when the hydraulic steel works are included as part of the scope of the civil works, which requires adaptation to the contract, most notably with respect to design responsibility but also potentially the testing regime.

Contracts for hydraulic steel works generally follow a design and build form, which is a form of procurement under which the owner appoints a contractor to design and construct the works, as opposed to a traditional contract under which the owner engages consultants to design the project and then a contractor to construct the project. Under a design-and-build procurement approach, the owner can either appoint the contractor to carry out all of the design work, or if the owner wishes to have more control over the design, he

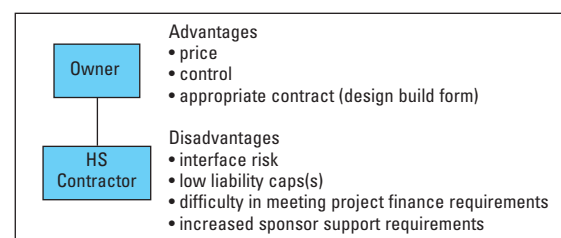


Fig. 1. Procurement of hydraulic steel works under stand-alone contracts.

can engage consultants to prepare a concept design and outline (or performance specification) and then engage the contractor to complete the design and carry out the construction.

Typical forms of design and build contract include the Conditions of Contract for Plant and Design-Build for Electrical and Mechanical Plant, and for Building and Engineering Works, Designed by the Contractor (the FIDIC Yellow Book) and the Conditions of Contract for EPC/Turnkey Projects (the FIDIC Silver Book). Although both the Yellow Book and Silver Book are commonly used in the hydropower industry (albeit often with extensive amendment), the Yellow Book would usually be more appropriate for hydraulic steel works procured on a stand-alone basis, because of its more balanced risk allocation.

Given the site-specific nature of hydropower, appropriate design for hydraulic steel works is critical, not least given the potential of penstocks and gates to leak or even fail, thereby raising significant safety concerns. Appropriate design can be facilitated by procuring hydraulic steel works by way of a form of design-build contract, such as the Yellow Book, which allocates design responsibility to the contractor^(b), includes an explicit 'fitness for purpose' warranty^(c), gives control, and approval rights over the design through an iterative process^(d) and, requires the design to comply with appropriate technical standards and applicable laws^(e).

The main disadvantages of procuring hydraulic steel works from one or more specialist contractor(s) are interface risk, low liability caps for such works, difficulty in meeting project finance requirements, and increased sponsor support requirements.

Interface risk in the context of hydraulic steel works refers to the risk associated with managing the interfaces between the hydraulic steel works and the civil works on the one hand, and the hydraulic steel works and the electro-mechanical works on the other hand. The potential for delays and cost overruns may be higher when multiple parties work in the same space under different contracts, requiring communications with, and coordination among, the owner, the design professional, other contractors and subcontractors, and suppliers, all of whom may have differing purposes and goals. At the very least there is more likelihood of disagreements among the contractors in relation to the planning and performance of activities at the site. Agreeing a tight and precise interface schedule among

contractors is key to managing the interface risks. Including an interface schedule within a robust interface agreement, to which all contractors become party, can help to avoid disputes, including by way of a dynamic work coordination mechanism, under the authority of the owner or engineer^(f).

The more separate contractual packages there are for the construction of any hydropower project, the lower the liability caps will be for the scope of works under each package. To illustrate this point, let us assume that the owner will negotiate a liability cap for the contractor of 100 per cent of the relevant contract value, as adjusted in accordance with such a contract. If an owner contracts separately for each of the hydraulic steel works, civil works and electro-mechanical works by way of contracts with a value of US\$ 20 million, US\$ 80 million, and US\$ 100 million respectively, the liability caps under each such contract will be likely to equal each amount as adjusted in accordance with the relevant contract (such as US\$ 20 million for the hydraulic steel works, as adjusted in accordance with the contract). However, if the same hydraulic steel works are contracted as part of the works for the electro-mechanical contract or the civil works contract, then the liability cap for the hydraulic steel works can equal the aggregate of such packages as adjusted in accordance with the relevant contract (US\$ 100 million or US\$ 120 million respectively, everything else being equal). Conversely, if an owner decides to split the hydraulic steel works into more than one package, with one lot for penstocks and another for the rest of the hydraulic steel works (including gates), then the liability caps will be lower still for each lot. Therefore, an owner will be more exposed to the amount by which liability can exceed a liability cap for hydraulic steel works if they are procured separately, and exposed further still where the hydraulic steel works are split into further contractual packages. Additional insurance may cover such liability to some extent, but this comes at a cost, which will need to be deducted from any cost savings achieved by splitting the scope of the hydraulic steel works into multiple packages.

When an owner uses project finance to fund the construction of a hydro project, there can be further issues with contracting separately for hydraulic steel works. As described below, project finance lenders require construction contracts and contractors to meet certain requirements (for example, the issuance of bank guarantees with international banks in a jurisdiction acceptable to lenders, legal opinions and collateral warranties for major equipment). However, this makes for a more complex and lengthy contract, compared with what most local suppliers of hydraulic steel works are used to, and as a result suppliers may not bid on such a contract. Even if enough potential suppliers bid on the hydraulic steel works contract, the requirements of project finance lenders may be difficult for the suppliers to meet and, if the suppliers do accept the contractual requirements, they may lack the experience and/or capacity to meet the requirements.

In a project finance context, increased interface risk, lower liability caps and an inability of hydraulic steel

^(b) Sub-Clause 4.1 (Contractor's General Obligations) of the FIDIC Yellow Book Conditions of Contract requires the Contractor to "design, execute and complete the Works in accordance with the Contract"; Sub-Clause 5.1 (General Design Obligations) of the FIDIC Yellow Book Conditions of Contract provides that the Contractor "shall carry out, and be responsible for, the design of the Works"; and Sub-Clause 5.1 (General Design Obligations) of the FIDIC Yellow Book Conditions of Contract includes a warranty by the Contractor that it has the "experience and capability necessary for the design".

^(c) Sub-Clause 4.1 [Contractor's General Obligations] of the Conditions of Contract of the FIDIC Yellow Book stipulates that "When completed, the Works shall be fit for the purposes for which the Works are intended as defined in the Contract".

^(d) Sub-Clause 5.2 [Contractor's Documents] of the FIDIC Yellow Book Conditions of Contract provides a detailed procedure for design submission, review and approval by the Engineer.

^(e) Sub-Clause 5.4 [Technical Standards and Regulations] of the FIDIC Yellow Book Conditions of Contract requires the "design, the Contractor's Documents, the execution and the completed Works" to "comply with the Country's technical standards, building, construction and environmental Laws applicable to the product being produced from the Works, and other standards specified in the Employer's Requirements, applicable to the works, or defined by the applicable Laws".

^(f) According to the International Finance Corporation: "The engineer will assume responsibility for contractor coordination, in particular for managing the interfaces among them. For larger HPPs this is a demanding and crucial activity that requires highly experienced engineering expertise.", Financing and contractual arrangements, Section 5.4, p. 36, "Hydroelectric Power. A Guide for Developers and Investors" [IFC].

The hydraulic steel works for the Moglicë plant, part of the Devoll scheme, were procured as part of the electro-mechanical works. This photo shows the diversion tunnel under construction. (Image courtesy of Statkraft).



works contractors to meet and/or effectively and efficiently discharge project finance requirements can cause lenders to require increased sponsor support. This will increase contingent liability on the balance sheet of the sponsors of a hydropower project, at least during the construction period.

Projects where hydraulic steel works were procured as a stand-alone contract include the 530 MW Alto Maipo hydro scheme in Chile, the 456 MW Upper Tamakoshi hydro project in Nepal [NEA, 2010³], the 172 MW Cheves hydro project in Peru [Water Power & Dam Construction, 2012⁴], the Giresun Aslancik dam and 120 MW hydropower plant in Turkey [Htit Makina, 2012⁵].

Procurement of hydraulic steel works as part of the electro-mechanical works

There is a view that hydraulic steel works have more in common with electro-mechanical equipment than with civil works. Both lots involve a large amount of steel, the design of hydraulic components, corrosion protection works, welding procedures which are often difficult, the requirement of a similar skill set for the site staff, and similar quality control procedures during the manufacturing process. However, perhaps the main reason for this view, at least in Europe, is that all three large electro-mechanical equipment suppliers in Europe can handle both lots (Voith, Andritz, and the former Alstom, now GE). Hiring one of the three large electro-mechanical equipment suppliers can reduce the number of companies involved in the project and on site, and therefore has the potential to reduce the interface risk, although often the only physical interfaces between the hydraulic steel works and the electro-mechanical works are at the draft tube and the interface and connection to the control system necessary to operate the gates, valves and other hydraulic structures.

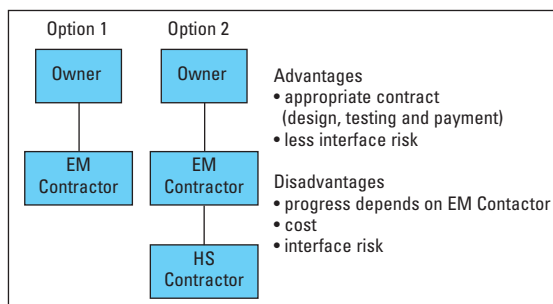


Fig. 2. Procurement of hydraulic steel works as part of the electro-mechanical works.

In addition to commonality in practical terms, contractually there is much to be said for including the hydraulic steel works as part of the scope of the contract for the electro-mechanical works. Given the importance of design for hydraulic steel works, it makes sense for the contractors to have the same design responsibility as the electro-mechanical contractor. Use of a design-build contract form, such as the FIDIC Yellow Book, will usually contain appropriate provisions on design responsibility which can apply for both categories of scope. In addition, a contract covering both electro-mechanical works and hydraulic steel works will usually contain suitable provisions on testing, which include performance tests which must be passed before handing over, to demonstrate whether the works conform with criteria specified in the Employer's Requirements⁽⁹⁾. Furthermore, such a contract will include payment provisions which provide for a lump-sum contract price and progress payments paid in instalments or against milestones in a schedule of payments, a payment structure which works well for hydraulic steel works and electro-mechanical works.

The main disadvantages of including the hydraulic steel works in the contract for the electro-mechanical works are usually that progress and completion of the works then becomes dependent on the electro-mechanical contractor, and potentially the cost, given that the usually foreign-based electro-mechanical contractor will either charge a mark-up on local suppliers of hydraulic steel works and/or import certain equipment (whether manufactured by the electro-mechanical contractor or a subcontractor).

Of course, including the hydraulic steel works in the scope of the electro-mechanical contractor does mean that the electro-mechanical contractor will have a number of interfaces with the civil contractor that need management. However, at least for projects above ground, technical interfaces between civil works and hydraulic steel works are rather limited in number and level of difficulty. The interfaces mainly involve the accuracy of the primary concrete structures. The loads generated by the hydraulic steel works which are transferred to the civil structures are rather simple to handle. Therefore, for above ground projects at least, interface risk is rarely a reason not to combine the hydraulic steel works with the electro-mechanical works.

Hydro projects where hydraulic steel works were included as part of the electro-mechanical works contract include the 256 MW Devoll project in Albania [Alstom, 2013⁶], the 136 MW Nuble project in Chile [Harris, 2015⁷], and the 1870 MW Gilgel Gibe III project in Ethiopia [Nazret, 2010⁸].

Procurement of hydraulic steel works as part of the civil works

If the hydraulic steel works are included in the civil works contract, then the civil contractor usually needs to find a subcontractor for the steel works because fabrication and installation of these works does not fall within the core business of civil works contractors. The civil contractor will often wish to avoid entering into a

⁽⁹⁾ Sub-Clause 4.1 Contractor's General Obligations of the Conditions of Contract of the FIDIC Yellow Book stipulates that "When completed, the Works shall be fit for the purposes for which the Works are intended as defined in the Contract".

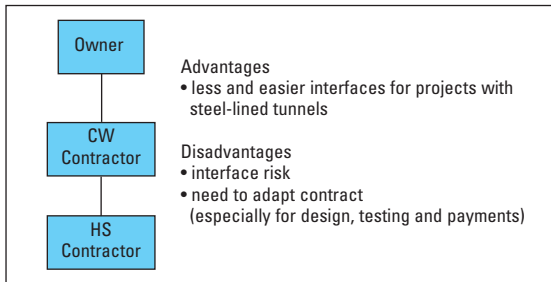


Fig. 3. Procurement of hydraulic steel works as part of the civil works.

subcontract with the electro-mechanical contractor, so it will often bring in a separate subcontractor for such works. Many civil works contractors experienced in hydropower construction are used to working with hydraulic steel works contractors, but notwithstanding this, if the subcontractor is under the responsibility of the civil contractor, there will be an additional interface, albeit at the subcontractor level.

In underground projects, on the other hand, combining civil works and hydraulic steel works in the same lot might be preferable, especially where steel-lined tunnels are involved. Steel-lined tunnels need grouting for a controlled transmission of the load between the steel and the rock. Doing the grouting from within the steel lining is a difficult job. The steel lining could easily be damaged during the grouting. Load transmission where the steel lining enters the powerhouse is also challenging. Excavation works and installation of the liner have to be coordinated very well. All these interfaces could be easier to handle for the owner of a hydropower project with steel-lined tunnels if hydraulic steel works and civil works are included together in one package.

Where it makes sense to include hydraulic steel works in the civil works contract, it will then usually become necessary to add certain provisions to the civil works contract, which apply to the hydraulic steel works only. First and foremost among these is design. It is a mistake to assume that a civil contractor does not have liability for design. A civil contractor will always be responsible for design of the temporary works and may have further design liability as specified in its contract, even including a ‘fitness for purpose’ obligation^(b). If including the hydraulic steel works in the civil works contract, it will usually be appropriate to add additional design provisions for these works based on a design-build contract form, such as the Yellow Book. In addition, it will be important to set out relevant testing provisions for the hydraulic steel works in a specification or elsewhere in the contract, given that the standard forms of contract used for civil works do not include performance testing. It may also be necessary to include progress payments for the hydraulic steel works based on milestones, rather than rely on the usual civil works contract payment approach based on measurement, bill of quantities and monthly payments.

^(b) Usually civil works are procured with Conditions of Contract for Construction for Building for Engineering Works Designed by the Employer (the FIDIC Red Book). Sub-Clause 4.1 Contractor’s General Obligations provides that the “Contractor shall design (to the extent specified in the Contract) ... the Works” and that if the Contract specifies that the Contractor shall design any part of the Permanent Works, then “unless other stated in the Particular Conditions, the Contractor shall be responsible for this part and it shall, when the Works are completed, be fit for such purposes for which the part is intended as specified in the Contract”.

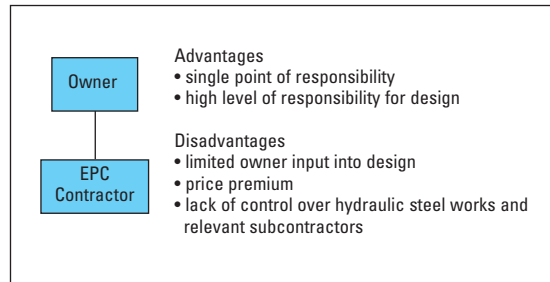


Fig. 4. Procurement of hydraulic steel works as part of an EPC contract.

Hydro projects where hydraulic steel works were included as part of the civil works include the 30 MW Nyadi project in Nepal [BPC⁹], the 80 MW Yamanli 2 project in Turkey [Hydro World, 2014¹⁰], and the Trung Son project in Vietnam [Devex¹¹].

Procurement of hydraulic steel works as part of an EPC contract

Procuring the construction of a hydropower project on an EPC basis can appeal to owners as it gives a single point of responsibility for delivering the entire project on a lump sum turnkey basis, with the great majority of risk being passed to the contractor. However, some consider it is only appropriate for simple projects, where design quality is not the main consideration. Under the EPC contract procurement approach, all the contract management is down to the contractor, and the owner and its engineer only sees the specifications issued to the contractor’s suppliers and subcontractors. Therefore, a key disadvantage of the EPC procurement approach is a lack of control over the hydraulic steel works and other subcontractors, although owners may mitigate this somewhat by naming a particular contractor as a nominated subcontractor for the works or requiring approval rights over the selected subcontractor.

Interface risk does not disappear with the EPC approach but it does transfer to the EPC contractor, which then has the responsibility to manage all interfaces. A further key disadvantage of the EPC approach to procurement is higher cost, given the usual price premium built in by EPC contractors, including mark-ups for works, which they sub-contract and may include the hydraulic steel works.

When the hydraulic steel works are procured as part of an EPC contract, the design responsibility of the contractor is usually even higher than in other design-build contracts⁽ⁱ⁾. Because of the turnkey nature of an EPC contract, the contractor will be responsible for the integration of the design and construction of the works. The Silver Book is commonly used for EPC contracts for hydropower projects. Sub-Clause 4.1 (Contractor’s General Obligations) of the Silver Book Conditions of Contract provides the same as Sub-Clause 4.1 (Contractor’s General Obligations) of the Yellow Book, which, “when completed, the Works shall be fit

⁽ⁱ⁾ It is important to note that design responsibility in the FIDIC Yellow Book does not lie exclusively with the Contractor. The Contractor is not responsible for errors or defects in the Employer’s Requirements or items of reference, unless an experienced contractor exercising due care would have discovered the error, fault or other defect before submitting its Tender (Sub-Clause 5.1 General Design Obligations of the FIDIC Yellow Book Conditions of Contract).

for the purposes for which the Works are intended as defined in the Contract.” However, Sub-Clause 5.1 of the Silver Book Conditions of Contract clearly allocates the responsibility for design errors to the contractor, notwithstanding any errors in data received^(l). This provision is often amended to allow the contractor to rely on certain information supplied by the employer.

Hydro projects where hydraulic steel works were included as part of an EPC contract include the 118 MW Nikachhu project in Bhutan [Power Technology, 2016¹²], the 84 MW New Bong Escape project in Pakistan, and the 250 MW Bujagali scheme in Uganda [Ketchum, 2012¹³].

Legal and commercial issues relevant to the procurement of hydraulic steel works

- **Indexation:** Fixed-price contracts give owners certainty over cost, which project finance lenders also prefer. However, a large part of the cost to the contractor for hydraulic steel works is made up of the price of materials, mainly steel, so any fixed price will necessarily include some buffer to allow for the rising cost of those materials. An alternative, for which a standard clause is provided in FIDIC standard form construction contracts, is to allow for indexation of costs to give the contractor protection against the rising prices of steel and other materials and the owner the opportunity to benefit from falling prices of steel and such materials. Including indexation thereby allows a better price. Project finance lenders will usually accept indexation though sometimes thresholds and limits will need to apply to its application. Where used, indexation will usually cover steel as a minimum, but it can also cover labour, supplies and general expenses.
- **Use of local contractors as opposed to foreign contractors:** As discussed, local contractors are often used for hydraulic steel works rather than foreign contractors. However, they may not be as capable of meeting the requirements of project finance.

^(l) “The Contractor shall be responsible for the design of the works and for the accuracy of the Employer’s Requirements (including design criteria and calculations) ... Any data received by the Contractor, from the Employer or otherwise shall not relieve the Contractor from his responsibility for the design and execution of the works.”

^(k) See, for example: *Lamphier v Phipos* (1838) 8 C and P; *Blyth v Birmingham Waterworks Company* (1856) 11 Ex Ch 781; and *Bolam v Friern Hospital Management Committee* (1957) 2 All ER 118.

^(l) See, for example: *Greaves & Co (Contractors) Ltd v Baynham Meikle and Partners* (1975) 3 All ER 99; and *Independent Broadcasting Authority v EMI Electronics Limited and BICC Construction Ltd* (1980) 14 BLR 1.

^(m) See, for example, *Lamphier v Phipos*, *Blyth v Birmingham Waterworks Company*, *Bolam v Friern Hospital Management Committee*, *Greaves & Co (Contractors) Ltd v Baynham Meikle and Partners*, and *Independent Broadcasting Authority v EMI Electronics Limited and BICC Construction Ltd*.

⁽ⁿ⁾ In *Viking Grain Storage v T.H. White Installations Ltd* (1987) 33 BLR 103, Judge John Davies said: “The virtue of an implied term of fitness for purpose is that it prescribes a relatively simple and certain standard of liability based on the ‘reasonable’ fitness of the finished product, irrespective of considerations of fault and of whether its unfitness derived from the quality of work or materials or design.”

^(o) Section 13 of the Supply of Goods and Services Act 1982 provides as follows: “In a contract for the supply of a service where the supplier is acting in the course of a business, there is an implied term that the supplier will carry out the service with reasonable care and skill.” See also Section 14, Sale of Goods Act 1979.

• **Design responsibility:** Under English law, contractors generally have to meet two standards for design: the obligation to use reasonable skill and care for design^(k), and the obligation to design a product that is fit for its intended purpose^(l). Either of these obligations may be implied rather than explicit under the common law^(m). To make out liability for a design failure, there is no need to show negligence where a fitness for purpose obligation is included expressly, implied at common law⁽ⁿ⁾ or imposed by statute^(o). In this context it is important to note that, where an owner engages a consultant to prepare design for hydraulic steel works under a FIDIC Client/Consultant Model Services Agreement (FIDIC White Book), then such a contract contains an obligation to exercise reasonable skill, care and diligence but not an obligation that the design be fit for purpose. A key motivation for this is the insurance market, given that professional indemnity insurance usually covers a failure to exercise reasonable skill and care, rather than fitness for purpose. Therefore, where the scope of hydraulic steel works is split between a consultant responsible for the design and a contractor responsible for fabrication and installation of such works according to such design, design liability can be weakened.

• **Defects notification period:** The defects notification period for hydraulic steel works is generally between 18 and 24 months. However, whether this period starts from the conclusion of the installation of the hydraulic steel works or taking over of the entire works under the relevant contract, or even taking over the entire powerplant, can be an issue, depending on the procurement approach adopted. This can be an concern where the hydraulic steel works contractor completes its works a long time before taking over.

• **Interface risk:** In short, fewer contractors usually mean fewer interfaces, which reduces the potential for delays, cost overruns and disputes. However, each hydropower project is different and interface risk alone may not be an important factor in choosing a procurement approach for hydraulic steel works, although it often is.

• **Price and payment mechanisms:** Hydraulic steel works probably lend themselves best to lump-sum pricing with progress payments based on achievement of milestones (such as design completion, fabrication, transport, installation, testing and commissioning). However, there can be variations on this. A hydro project in South America mainly used lump-sum pricing but also had an adjustment mechanism for the length and pressure of the pressure pipe and unit rates for spare parts.

• **Testing and commissioning:** Testing for hydraulic steel works can include shop hydrostatic and factory acceptance tests (assembly and functional testing but not pressure testing), field hydrostatic tests, field inspection, other site inspection tests, including surface inspection (penetrant) tests, destructive testing of steel plates and weld seams, non-destructive testing of welds and, after installation, pressure testing of hydraulic systems and testing of pumps and accumulators. In each case, clear procedures for acceptance must be set out. It may sometimes make sense for an owner to engage an independent third party to test hydraulic steel works.



Hydraulic steel works can also be procured as part of an EPC contract, as was the case with the New Bong Escape project in Pakistan. (Image by courtesy of Andy Thick).

- *Size of packages:* One consideration sometimes made by owners in deciding whether to tender hydraulic steel works as part of the electro-mechanical contract or the civil works contract is the size of the packages for each option. Some wish to have two lots with equally distributed budget and will allocate the hydraulic steel works scope to achieve this. However, others view this consideration as irrelevant.

Project finance requirements

This section sets out common project finance lender requirements for construction contracts that will also need to be considered in the procurement of hydraulic steel works. These requirements will probably also apply, in varying degrees, where alternative sources of finance are used such as commercial bonds and green bonds and, to a lesser degree, concessionary finance:

- *Risk allocation:* Project finance lenders generally look for project risks to pass through to the party most able to bear or manage them. What this usually means is that senior lenders limit the risk taken by them and the owner/borrower and require its allocation to equity investors, contractors, guarantors and insurers. The classic way to achieve this risk allocation is by procuring the project on an EPC turnkey basis, but this does not always make sense for hydropower projects.

- *Direct agreement:* The contractor needs to enter into an agreement with the owner/borrower and the senior lenders (or their agents) called a 'direct agreement', because it gives the lenders (or their agent) a direct contractual link to the contractor and allows the lenders (or their agents) to step in to the relevant contract in certain circumstances.

- *Security package:* Lenders will require that the contractor provide the owner with an advance bank guarantee where the owner is required to make an advance payment as well as a performance security to protect against contractor breach or insolvency. In addition, depending on the balance sheet of the relevant contractor, lenders will require a suitable parent company guarantee in favour of the owner.

- *Performance criteria and shortfalls:* Working closely with an independent engineer, project finance lenders will focus on clarity with respect to the performance criteria the facility is required to meet and the consequences if such performance criteria are not met. Although performance-liquidated damages linked to lost revenue for the underperforming facility often make sense for performance shortfalls for electro-mechanical works, it is unlikely that they will be appropriate for hydraulic steel works.

- *Delay:* Lenders require a fixed completion date and delay liquidated damages with a right to termi-

nate for the owner in the event that completion is not achieved by a longstop date and a cap on delay liquidated damages is reached.

- *Defects liability:* The defects liability period will usually need to equal a minimum of two years from take over of the works. Lenders will also review any interface with the operation and maintenance contractor running the facility following takeover.

- *Caps on liability:* Lenders will require these to be at levels appropriate for the market, and to contain suitable exclusions.

- *Insurance:* With input from an insurance advisor, lenders will review the contract to ensure that risks are mitigated by appropriate and adequate insurance cover.

- *Legal opinions:* Lenders require opinions on the authorization and capacity of each of the parties of the hydraulic steel works to enter into the contract.

- *Consistency with other contract documents:* A recent English case^(m) highlights the potential for problems when there is inconsistency in the level of design responsibility stated in the contract conditions compared to the technical schedules.

No single approach prevails

The procurement of hydraulic steel works raises similar questions to the procurement of any aspect of scope for a hydro project. However, because of the nature of these works and the site-specific nature of hydro projects, there is no single accepted market approach to procurement process. Put slightly differently, the particular procurement approach which is appropriate, will vary from project to project.

It is also possible that a hybrid approach combining more than one of those outlined in this paper could make sense. For example, it has been suggested that hydraulic steel works might benefit from being split between the electro-mechanical and civil contractors, with the steel penstock being allocated to the civil contractor and the gates, valves and balance of hydraulic steel works being allocated to the electro-mechanical contractor, and leaving the design of the penstock to the designer (rather than the civil contractor). ◇

Acknowledgements

The author gratefully acknowledges assistance from the following people in the research for this paper: Bjorn Brandzaeg, Clean Energy Group; Ajay Chaudhary, Mott MacDonald; Sverre Edvardsson; James Hannon, Sarawak Energy; Emre Köken, Dolsar; Arturo Ledesma, Norconsult Peru; Bryan Leyland; Khawaja Muhammad, Neelum Jhelum Hydro-Electric Project; Andreas Panenka; Jayaraman Punidhan; Sandra Salamanca, Fountain Intertrade Corporation; Peter Rae, Peter Rae Hydro Consulting Ltd; Jon Einar Værnes; and, others who did not wish to be named.

^(m) *MT Højgaard A/S v E.on Climate and Renewables UK Robin Rigg East Limited and another* [2015] EWDC Civ 407.

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Alex Blomfield completed his law degree and a Masters of International Law at the University of Sydney, New South Wales, Australia. He subsequently practised as a lawyer in Sydney, Melbourne, London and Oslo before returning to London in 2012, where he is now based. His practice centres on energy-related infrastructure development and finance and he specializes in the development and financing of projects worldwide. He has advised and represented project sponsors, national governments, state-owned utilities, petroleum producers, international consortia and development finance institutions in relation to the development, privatization and/or financing of projects, located in more than 36 countries worldwide. Since practising in Norway, Alex has developed a particular expertise advising project sponsors on the development, construction and financing of hydropower projects. He has advised on hydropower projects in 15 countries across Africa, Latin America, Europe and Asia.